CLAIMS

We claim:

1. A ceramic body of controlled pore size and distribution comprising the thermolysis product of a carboxylate-alumoxane represented by the formula $[Al(O)_x(OH)_y(O_2CR)_z]_n$, wherein x is from 0 to 1.5, y is from 0 to 3, z is from 0 to 3, n is greater than 6, and R is hydrogen or an organic group.

2. The ceramic body of claim 1 wherein each R, which may be the same or different, is hydrogen or an organic group selected from the group consisting of alkyl, alkenyl, aromatic, haloalkyl, haloalkenyl, and haloaromatic groups or alkyl, alkenyl, and aromatic ether groups or an organic group containing a hetero-atom including, oxygen, nitrogen, sulfur, phosphorous.

3. The ceramic body of claim 2 wherein the group (O_2CR) is derived from a carboxylic acid selected from the group consisting of acetic acid, methoxyacetic acid, methoxyethoxyacetic acid, and methoxyethoxyethoxyacetic acid.

4. The ceramic body of claim 2 wherein the carboxylate-alumoxane is the reaction product of a carboxylic acid and boehmite.

5. The ceramic body of claim 2 wherein the carboxylate-alumoxane is the reaction product of a carboxylic acid and pseudo-boehmite.

6. The ceramic body of claim 2 wherein the carboxylate-alumoxane is the reaction product of two or more carboxylic acids and boehmite.

7. The ceramic body of claim 6 wherein the carboxylate-alumoxane is the reaction product of the sequential reaction of two or more carboxylic acids with boehmite.

8. The ceramic body of claim 6 wherein the carboxylate-alumoxane is the reaction product of the parallel reaction of two or more carboxylic acids with boehmite.

9. The ceramic body of claim 6 wherein the carboxylate-alumoxane is the reaction product of the sequential reaction of a first carboxylic acid with boehmite to make a product, followed by the reaction of said product with a second carboxylic acid.

10. The ceramic body of claim 6 wherein the carboxylate-alumoxane is the reaction product of two or more carboxylic acids and pseudo-boehmite.

11. The ceramic body of claim 9 wherein the carboxylate-alumoxane is the reaction product of the sequential reaction of a first carboxylic acid with pseudo-boehmite to make a product, followed by the reaction of said product with a second carboxylic acid.

12. A ceramic body of controlled pore size and distribution comprising the thermolysis products of a carboxylate-alumoxane represented by the formula $[Al(O)_x(OH)_y(O_2CR)_z(O_2CR')_{z'}]_n$, wherein x is from 0 to 1.5, y is from 0 to 3, z is from 0 to 3,

34. The porous ceramic filter of claim 32 wherein the carboxylate is derived from a carboxylic acid selected from the group consisting of acetic acid, methoxyacetic acid, methoxyethoxyacetic acid, and methoxyethoxyethoxyacetic acid.

35. A fiber reinforced material comprising a fiber, and a fiber coating comprising a porous ceramic composite of a nano-particle comprising the thermolysis product of the reaction product of a carboxylate-alumoxane with an aluminum oxide wherein the pore size and pore distribution of the ceramic composite are controlled by the substituent on the carboxylate-alumoxane.

36. The fiber reinforced material of claim 36 wherein the aluminum oxide comprises boehmite.

37. The fiber reinforced material of claim 36 wherein the substituent on the carboxylate is selected from the group consisting of alkyl, alkenyl, aromatic, haloalkyl, haloalkenyl, and haloaromatic groups or alkyl, alkenyl, and aromatic ether groups or an organic group containing a hetero-atom including, oxygen, nitrogen, sulfur, phosphorous.

38. The fiber reinforced material of claim 36 wherein the carboxylate is derived from a carboxylic acid selected from the group consisting of carboxylic acid, acetic acid, methoxyacetic acid, methoxyethoxyacetic acid, and methoxyethoxyethoxyacetic acid.

~~39. A method of controlling the porosity and pore size distribution of ceramic bodies~~ comprising

reacting boehmite with a carboxylic acid to produce carboxylate-alumoxane nanoparticles,

drying the carboxylate-alumoxane nano-particles,

re-dissolving the carboxylate-alumoxane nano-particles in a solvent,

drying the nano-particles,

firing the ~~dried~~ nano-particles ~~at a temperature greater than 300 °C.~~

40. The method of claim 39 wherein the boehmite is pseudo-boehmite.

41. The method of claim 39 wherein the ceramic body comprises the thermolysis product of a carboxylate-alumoxane represented by the formula $[Al(O)_x(OH)_y(O_2CR)_z]_n$, wherein x is from 0 to 1.5, y is from 0 to 3, z is from 0 to 3, n is greater than 6, and R is hydrogen or an organic group.

42. The method of claim 41 wherein each R, which may be the same or different, is hydrogen or an organic group selected from the group consisting of alkyl, alkenyl, aromatic, haloalkyl, haloalkenyl, and haloaromatic groups or alkyl, alkenyl, and aromatic ether groups or an organic group containing a hetero-atom including, oxygen, nitrogen, sulfur, phosphorous.

~~43~~ 6. The method of claim ~~41~~ 3 wherein the carboxylate is derived from a carboxylic acid selected from the group consisting of acetic acid, methoxyacetic acid, methoxyethoxyacetic acid, and methoxyethoxyethoxyacetic acid.

Sub C1

44. The ceramic body of claim 43 wherein the carboxylate-alumoxane is the reaction product of a carboxylic acid and boehmite.

45. The ceramic body of claim 43 wherein the carboxylate-alumoxane is the reaction product of a carboxylic acid and pseudo-boehmite.

46. The ceramic body of claim 43 wherein the carboxylate-alumoxane is the reaction product of two or more carboxylic acids and boehmite.

47. The ceramic body of claim 46 wherein the carboxylate-alumoxane is the reaction product of the sequential reaction of two or more carboxylic acids with boehmite.

48. The ceramic body of claim 46 wherein the carboxylate-alumoxane is the reaction product of the parallel reaction of two or more carboxylic acids with boehmite.

49. The ceramic body of claim 46 wherein the carboxylate-alumoxane is the reaction product of the sequential reaction of a first carboxylic acid with boehmite to make a product, followed by the reaction of said product with a second carboxylic acid.

50. The ceramic body of claim 46 wherein the carboxylate-alumoxane is the reaction product of two or more carboxylic acids and pseudo-boehmite.

51. The ceramic body of claim 49 wherein the carboxylate-alumoxane is the reaction product of the sequential reaction of a first carboxylic acid with pseudo-boehmite to make a product, followed by the reaction of said product with a second carboxylic acid.

Sub D3

~~52. The method of claim 39, further comprising introducing the dissolved carboxylate-alumoxane nano-particles to a ceramic support.~~

~~53. The method of claim 52 wherein drying of the nano-particles takes place on the support.~~

~~54~~ 16. The method of claim ~~53~~ 15 wherein the support comprises a mold.

~~55~~ 17. The method of claim ~~54~~ 16 wherein the mold comprises a porous material.

~~56~~ 18. The method of claim ~~55~~ 17 wherein the porous material comprises a filter.

~~57~~ 19. The method of claim ~~56~~ 18 wherein the filter comprises a frit.

~~58~~ 20. The method of claim ~~39~~ 1 wherein the solvent comprises water.

~~59~~ 21. The method of claim ~~39~~ 1 wherein the ceramic body comprises a membrane.

~~60. The method of claim 39 wherein the ceramic body comprises a membrane.~~

~~61. The method of claim 39 further comprising infiltrating the dissolved carboxylate-alumoxane nano-particles to a ceramic support~~

Sub D3

~~62~~ 22. The method of claim ~~39~~ 1 further comprising mixing two or more carboxylic acids prior to reacting boehmite with a carboxylic acid to produce carboxylate-alumoxane nanoparticles.

~~63~~ 34. The method of claim ~~39~~ further comprising reacting boehmite sequentially with two or more carboxylic acids.

~~64. The method of claim 39 further comprising dip-coating a fiber in the mixture of re-dissolved carboxylate-alumoxane~~ nano-particles and solvent.

Sub D4

~~65~~ 26. The method of claim ~~64~~ 25 wherein the fiber comprises a carbon fiber.

~~66~~ 27. The method of claim ~~64~~ 25 wherein the fiber comprises a silicon carbide fiber.

~~67~~ 28. The method of claim ~~64~~ 25 wherein the fiber comprises a kevlar fiber.

~~68~~ 29. The method of claim ~~64~~ 25 wherein the fiber comprises a sapphire fiber.

~~69~~ 30. The method of claim ~~64~~ 25 wherein the fiber comprises a monofilant fiber.

~~70~~ 31. The method of claim ~~64~~ 25 wherein the fiber comprises a woven cloth.

~~71~~ 32. The method of claim ~~64~~ 25 wherein the dried nano-particles are fired at a temperature sufficient to drive off the volatiles.

~~72~~ 33. The method of claim ~~64~~ 25 wherein the dried nano-particles are fired at a temperature sufficient to drive off the organics.

~~73. The method of claim 39 wherein the dried nano-particles are fired slowly at a temperature~~ sufficient to burn off organic constituents.

Sub D5

74. The method of claim 39 wherein the dried nano-particles are fired at a temperature between 25 °C and 225 °C.

75. The method of claim 74 further comprising holding the nano-particles at a temperature of 225 °C for 30 minutes.

76. The method of claim 74 wherein the nano-particles are fired at a temperature that is ramped from 25 °C to 225 °C at a rate of 1 °C per minute.

77. The method of claim 76 further comprising holding the nano-particles at a temperature of 225 °C for 30 minutes.

78. The method of claim 39 further comprising holding the nano-particles at a temperature of 300 °C for 80 minutes.

79. The method of claim 39 further comprising firing the nano-particles by ramping the temperature to 1100 °C at a rate of 2 °C per minute.

80. The method of claim 79 further comprising holding the nano-particles at a temperature of 1100 °C for 400 minutes.

81. The method of claim 39 further comprising cooling the nano-particles slowly to room temperature.

z' is from 0 to 3, n is greater than 6, wherein each R, which may be the same or different, is hydrogen or an organic group, and wherein each R', which may be the same or different, is hydrogen or an organic group.

13. The ceramic body of claim 12 wherein each R is hydrogen or an organic group selected from the group consisting of alkyl, alkenyl, aromatic, haloalkyl, haloalkenyl, and haloaromatic groups or alkyl, alkenyl, and aromatic ether groups or an organic group containing a hetero-atom including, oxygen, nitrogen, sulfur, phosphorous, and wherein each R', which may be the same or different, is hydrogen or an organic group selected from the group consisting of alkyl, alkenyl, aromatic, haloalkyl, haloalkenyl, and haloaromatic groups or alkyl, alkenyl, and aromatic ether groups or an organic group containing a hetero-atom including, oxygen, nitrogen, sulfur, phosphorous.

14. The ceramic body of claim 13 wherein the group (O_2CR) is derived from a carboxylic acid selected from the group consisting of acetic acid, methoxyacetic acid, methoxyethoxyacetic acid, and methoxyethoxyethoxyacetic acid.

15. The ceramic body of claim 13 wherein the carboxylate-alumoxane is the reaction product of a carboxylic acid and boehmite.

16. The ceramic body of claim 13 wherein the carboxylate-alumoxane is the reaction product of a carboxylic acid and pseudo-boehmite.

17. The ceramic body of claim 13 wherein the carboxylate-alumoxane is the reaction product of two or more carboxylic acids and boehmite.

18. The ceramic body of claim 17 wherein the carboxylate-alumoxane is the reaction product of the sequential reaction of two or more carboxylic acids with boehmite.

19. The ceramic body of claim 17 wherein the carboxylate-alumoxane is the reaction product of the parallel reaction of two or more carboxylic acids with boehmite.

20. The ceramic body of claim 17 wherein the carboxylate-alumoxane is the reaction product of the sequential reaction of a first carboxylic acid with boehmite to make a product, followed by the reaction of said product with a second carboxylic acid.

21. The ceramic body of claim 17 wherein the carboxylate-alumoxane is the reaction product of two or more carboxylic acids and pseudo-boehmite.

22. The ceramic body of claim 17 wherein the carboxylate-alumoxane is the reaction product of the sequential reaction of a first carboxylic acid with pseudo-boehmite to make a product, followed by the reaction of said product with a second carboxylic acid.

23. A porous ceramic body comprising the thermolysis product of the reaction product of a carboxylic acid with boehmite, represented by the formula $[Al(O)_x(OH)_y(O_2CR)_z]_n$, wherein

the porosity and pore size distribution of the ceramic body is controlled by the selection of the number, z, of carboxylate groups.

24. The porous ceramic body of claim 23 wherein the porosity and pore size distribution are controlled by the selection of the substituent R on a carboxylate group.

25. The porous ceramic body of claim 24 wherein each substituent R, which may be the same or different, is hydrogen or an organic group selected from the group consisting of alkyl, alkenyl, aromatic, haloalkyl, haloalkenyl, and haloaromatic groups or alkyl, alkenyl, and aromatic ether groups or an organic group containing a hetero-atom including, oxygen, nitrogen, sulfur, phosphorous.

26. The porous ceramic body of claim 25 wherein the group (O_2CR) is derived from a carboxylic acid selected from the group consisting of acetic acid, methoxyacetic acid, methoxyethoxyacetic acid, and methoxyethoxyethoxyacetic acid.

27. A porous ceramic composite comprising a nano-particle comprising the thermolysis product of the reaction product of a carboxylate-alumoxane with an aluminum oxide wherein the pore size and pore distribution of the ceramic composite are controlled by the substituent on the carboxylate-alumoxane.

28. The porous ceramic composite of claim 27 wherein the aluminum oxide comprises boehmite.

29. The porous ceramic composite of claim 28 wherein the substituent on the carboxylate group is selected from the group consisting of hydrogen, alkyl, alkenyl, aromatic, haloalkyl, haloalkenyl, and haloaromatic groups or alkyl, alkenyl, and aromatic ether groups or an organic group containing a hetero-atom including, oxygen, nitrogen, sulfur, phosphorous.

30. The porous ceramic composite of claim 28 wherein the carboxylate is derived from a carboxylic acid is selected from the group consisting of acetic acid, methoxyacetic acid, methoxyethoxyacetic acid, and methoxyethoxyethoxyacetic acid.

31. A porous ceramic filter of controlled pore size and pore size distribution comprising a nano-particle comprising the thermolysis product of the reaction product of a carboxylate-alumoxane with an aluminum oxide wherein the pore size and pore distribution of the ceramic composite are controlled by the substituent on the carboxylate-alumoxane.

32. The porous ceramic filter of claim 31 wherein the aluminum oxide comprises boehmite.

33. The porous ceramic filter of claim 32 wherein the substituent on the carboxylate is selected from the group consisting of hydrogen, alkyl, alkenyl, aromatic, haloalkyl, haloalkenyl, and haloaromatic groups or alkyl, alkenyl, and aromatic ether groups or an organic group containing a hetero-atom including, oxygen, nitrogen, sulfur, phosphorous.